

## **REMARKS**

Claims 10-24 and 26-34 are currently in the application. Claims 10, 13, 14 and 26 have been amended to correct the designation “nl/n” which means “normal liter” and to conform with such designation in the specification, such as indicated in Table 5, for example. Claims 25 and 30 have been cancelled, and new claims 31-34 have been added.

### **Rejection of Claims 10-14 and 19-24 as Anticipated Under 35 U.S.C. § 102**

By the present amendment, claim 10 has been amended to recite that the catalyst used in the first stage comprises nickel-molybdenum-titania on gamma alumina and that used in the second reaction stage comprises cobalt-molybdenum-titania on gamma alumina. Support for such recitations is found in Table 3 on page 21 of the present application.

Since Evans et al do not disclose use of a titania-containing catalyst nor a gamma alumina support in addition to other features of claim 10, rejection of claim 10 and the claims dependent therefrom as being anticipated should be withdrawn. Decisional law requires that a rejection under Section 102 cannot be maintained unless each and every element of the claim is found in the reference relied on. Accordingly, the rejection of claims 10-14 and 19-24 should be withdrawn.

### **Rejection of Claims 15-18 and 24 as Anticipated or Obvious**

Claims 15-18 and 24 are rejected under 35 U.S.C. § 102(b) as anticipated by or in the alternative, under 35 U.S.C. § 103(a) as being obvious over Evans et al.

Since claims 15-18 and 24 are ultimately dependent from claim 10 and contain all of the limitations of claim 10, as well as additional limitations, such claims are not anticipated by Evans et al for the reasons given previously above.

As to the rejection of claims 15-18 and 24 as being obvious over Evans et al, submitted herewith is an approved, but unsigned Declaration Under Section 1.132 of Dr. Jorge Ancheyta-Juárez, who is co-inventor of the present application and an expert in the field of upgrading heavy oils (paras. 1 and 2 of the declaration). The executed declaration will be submitted shortly.

Comparative Tests A and B, which are described in paragraphs 5 and 6 of the Ancheyta-Juárez declaration, describe tests using a Ni-Mo-Titania catalyst on gamma alumina in an ebullated bed for hydrotreatment of a vacuum residue feed in each test. As stated in paragraph 5 of the Ancheyta-Juárez declaration, the tests demonstrate that the use of lower operating pressure, as in Test A, can achieve conversion and removal of impurities, such as sulfur, asphaltenes and metals from heavy hydrocarbons, such as vacuum residues, comparable to the use of higher operating pressure for a similar vacuum residue, as in Test B.

As pointed out in paragraph 7 of the Ancheyta-Juárez declaration, the test results, although with slightly different vacuum residue feeds, essentially show that the conversion removal of sulfur, nitrogen, asphaltene and metals in Test A using an operating pressure of 100 kg/cm<sup>3</sup> are comparable or even better than those obtained in Test B when a higher pressure of 185 kg/cm<sup>3</sup> is used.

As described in paragraph 8, use of the lower operating pressure achieved greatly improved sulfur (85.92% v. 52.96%) and asphaltene removal (85.58% v. 68.56%), as well as improved metal removal (93.96% v. 86.39 %). The magnitude of such differences using less severe conditions is highly unpredictable. Likewise, the use of lower operating pressure achieved a higher API gravity product (21.9 v. 18) and higher total volumetric conversion (72.2% v. 71.9%). As further indicated in paragraph 8 of the declaration, these results are very significant, since using lower process pressure presents fewer problems, such as sediment formation and is more cost effective than using higher pressures or temperatures.

As pointed out in paragraph 9, the hydrodemetallization catalyst (HDM) and hydrodesulfurization catalyst (HDS) of the present invention comprises nickel-molybdenum-titania supported on gamma alumina and the HDS catalyst of the present invention comprises cobalt-molybdenum-titania on gamma alumina, as compared with Evans et al HDM catalyst, which does not contain nickel or titania and is supported on silica-alumina, rather than gamma alumina. Likewise, the Evans et al HDS catalyst does not contain titania nor is use of a gamma alumina support disclosed.

As concluded by Dr. Ancheyta-Juárez in paragraph 10, the results of the tests discussed above including low sediment formation, that are achieved using lower temperature and pressure with the titania-containing catalysts supported on gamma alumina, are neither apparent nor obvious from the Evans et al patent. As indicated in the declaration, the catalysts of the present invention when used with the lower temperatures and pressure provide the advantages of lower operating costs and simplicity.

Such unobvious results are contrary to the teaching of Evans et al who specifically state in column 12, lines 18-23 that the advantage of their two catalyst system is that it “can be operated at higher temperature which gives higher conversion and a higher quality product than can be obtained with the single catalyst system which is substantially more expensive.” (Our emphasis). The Evans et al’s stated desire to use higher operating temperatures with their two catalyst system teaches away from the results demonstrated by the Ancheyta-Juárez declaration that are achievable using Applicants’ titania-containing, gamma alumina supported catalyst in a lower pressure, lower temperature system, which is substantially less expensive to operate than Evans et al’s recommended higher temperature, higher pressure system.

Accordingly, it is submitted that the rejection of claims 15-18 and 24 as anticipated or obvious over Evans et al should be withdrawn.

### **Rejection of Claim 25-30 as being Obvious**

Claims 25-28 and 30 are rejected as being obvious under 35 U.S.C. § 103(a) over Evans et al in view of Trueba et al. Claim 29 is not mentioned in the statement of the rejection; however, it is mentioned in the discussion of the rejection, so that it is assumed it was intended to be included.

The Examiner has taken the position that since Evans et al disclose use of an alumina support (col. 7, line 63, and Table I in col. 10), it would be obvious to use gamma alumina in view of Trueba et al, who discloses (p. 3393, first paragraph) as being “perhaps the most important with direct application as a catalyst and catalyst support in the petroleum industry” would make it obvious to use.

By the present Amendment, claims 25 and 30 have been cancelled, and claim 26 has been amended to recite that the catalyst used in the first stage comprises a nickel-molybdenum-titania on gamma alumina and that used in the second reaction stage comprises a cobalt-molybdenum-titania on gamma alumina. As indicated above, support for such recitation is found in Table 3 on page 21 of the present Application.

Since neither Evans et al nor Trueba et al disclose use of an HDM nickel-molybdenum-titania on gamma alumina catalyst or an HDS catalyst comprising cobalt-molybdenum-titania on gamma alumina, the reference combination of Evans et al in view of Trueba et al cannot render amended claim 26 obvious. Where a reference does not disclose a feature of a claim relied on to distinguish the prior art, it cannot suggest modifying the prior art to contain that feature, see *In re Civitello*, 144 USPQ 10 (1964) wherein the CCPA stated:

Since Haslacher fails to disclose the feature of the claim relied on, we do not agree with the Patent Office that it would suggest modifying the Craig bag to contain that feature. The Patent Office finds the suggestion, only after making a modification which is not suggested, as we see it, by anything other than appellant's own disclosure. This is hindsight reconstruction. It does not establish obviousness. (Emphasis the Court's).

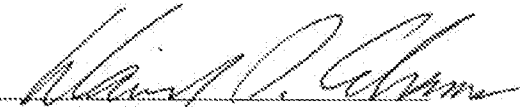
See also *In re Glass*, 176 USPQ 489 (1973) wherein the CCPA stated that it is error to ignore specific limitations distinguishing over the references. Thus, since the prior art do not disclose the claimed method, the rejection based on the prior art should be withdrawn, since it is based on a hindsight reconstruction and does not establish obviousness.

Accordingly, the rejection of claims 26-29 as being obvious under 35 U.S.C. § 103(a) over Evans et al in view of Trueba et al should be withdrawn.

New claims 31-34 have been added, which claims recite that the weight % titania exceeds the weight % nickel in the first reaction state catalyst and exceeds the weight % cobalt in the second reaction stage catalyst. Support for such recitations is found in catalysts of Table 3 on page 21 of the present specification. Since claims 31-32 depend from claim 10 and claims 33 and 34 ultimately depend from claim 26, claims 31-34 similarly distinguish the combination of Evans et al in view of Trueba et al and are patentable thereover.

For the foregoing reasons, it is respectfully requested that the rejection of claims 10-24 and 26-29 be withdrawn and this application passed to issue. Prompt and favorable examination is requested.

Respectfully submitted,

  
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Dated: Oct. 1, 2009

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	:	
	:	
Jorge Ancheyta-Juarez et al.	:	Art Unit: 1797
	:	
Serial No.: 10/563,577	:	Examiner: B. McCaig
	:	
Filed: June 21, 2006	:	
	:	
For: PROCESS FOR THE CATALYTIC	:	
HYDROTREATMENT OF HEAVY	:	
HYDROCARBONS OF PETROLEUM	:	

**DECLARATION UNDER 37 C.F.R. § 1.132**

I, Jorge Ancheyta-Juárez, hereby declare:

1. I received a split PhD degree in Chemical Engineering from Metropolitan Autonomous University (Mexico) and Imperial College London (UK) in 1998. I have been employed by “Instituto Mexicano del Petroleo” since 1989, and have worked since that time in the development of catalysts and processes for petroleum refining. At present I am R&D Project Leader and much of my research since has been devoted to the development of catalysts and processes for upgrading of petroleum.

2. I consider myself an expert in the field of upgrading of heavy oils. Part of my research work in this topic has been summarized recently in the books: “Hydroprocessing of Heavy Oils and Residua” by J. Ancheyta and J. G. Speight, Taylor and Francis Group, Boca Raton (2008), and “Asphaltenes: Chemical Transformations during Hydroprocessing of Heavy Oils” by J. Ancheyta, F. Trejo, and M. S. Rana, Taylor and Francis Group, Boca Raton (2009).

3. I am a co-inventor of the process described and claimed in the above-identified U.S. patent application.

4. I have reviewed and am familiar with U.S. Patent No. 4,657,664 to Evans et al entitled “Process for Demetallization and Desulfurization of Heavy Hydrocarbons”(“Evans et al”). In my opinion Evans et al. do not disclose nor render obvious our invention. While Evans et al. disclose broad temperature and pressure ranges, Evans et al. teach utilization of higher temperatures rather than lower pressures to achieve high conversion and removal of impurities, such as sulfur, asphaltenes and metals, and do not teach or suggest to one of ordinary skill in the art that the use of lower pressures can also achieve high conversion and removal of such impurities. Moreover, the sediment formation in the process of our invention is much lower than the commercially operable limit (0.8 wt%), whereas the sediment formation in Evans’ process is very close or even higher than the limit value (0.63 to 1.18 wt%, in Table IV of Evans et al).

5. The following tests demonstrate that the use of a lower operating pressure can achieve comparable conversion and removal of impurities, such as sulfur, asphaltenes and metals from heavy hydrocarbons, such as vacuum residues. Using higher pressure does not have great advantage in respect to removal of impurities, such as sulfur, asphaltenes and metals from heavy hydrocarbons, such as vacuum residues.

In Test A, the hydrotreatment of a vacuum residue having the properties:

Properties	ASTM Method	Values
API Gravity	D-287	1.87
Total sulfur, weight%	D-4294	5.07
Total nitrogen, wppm	D-4629	6,200
Ramsbottom carbon, weight%	D-524	25.41
Asphaltenes, weight%	D-3279	25.46
Metals, wppm		
Ni+V		777.9
Sediments and sludge, weight%	D4870	0.0
Fraction IBP-538°C <sup>+</sup> , volume%		0.0

was conducted in a catalytic ebullated-bed reactor using the Ni-Mo-Titania on gamma alumina catalyst (Table 3 of our Application) under the following operating conditions, including a pressure of 100 kg/cm<sup>2</sup>:

<u>Operating conditions</u>	
<b><u>Temperature, °C</u></b>	400
Pressure, kg/cm <sup>2</sup>	100
LHSV, h <sup>-1</sup>	0.25
H <sub>2</sub> /HC ratio, nl/ l	2,671
Purity of hydrogen, mole%	100

The hydrotreated vacuum residue had the following properties and composition:



Properties	ASTM Method	Hydrotreated residue
API Gravity	D-287	21.19
Total sulfur, weight%	D-4294	0.714
Total nitrogen, wppm	D-4629	3,800
Asphaltenes, weight%	D-3279	3.67
Metals, wppm		
Ni+V		47
Sediments and sludge, weight%	D-8470	1.38
Conversion, volume%		75.2
Composition, volume%		
Fraction IBP-170°C		6.5
Fraction 170-360°C		36.4
Fraction 360-538°C		32.3
Fraction 538°C+		24.8
Fraction IBP-538°C+		75.2

6. For comparative purposes, a second test, Test B, was conducted in which a vacuum residue having the properties:

Properties	ASTM Method	Values
API Gravity	D-287	3.73
Total sulfur, weight%	D-4294	4.507
Total nitrogen, wppm	D-4629	6,100
Conradson carbon, weight%	D-524	22.59
Asphaltenes, weight%	D-3279	17.75
Metals, wppm		
Ni+V		502.6
Sediments and sludge, weight%	D4870	0.0
Fraction IBP-538°C, volume%		0.0

was subjected to hydrotreatment also using the Ni-Mo-Titania on gamma alumina catalyst of Test A in an ebullated bed reactor but at a higher pressure of 185 kg/cm<sup>2</sup> as follows:

<u>Operating conditions</u>	
<b><u>Temperature, °C</u></b>	420
Pressure, kg/cm <sup>2</sup>	185
LHSV, h <sup>-1</sup>	0.30
H <sub>2</sub> /HC ratio, nl/ l	1,335
Purity of hydrogen, mole%	100

The hydrotreated vacuum residue has the following properties:

Properties	ASTM Method	Hydrotreated residue
API Gravity	D-287	18.0
Total sulfur, weight%	D-4294	2.12
Total nitrogen, wppm	D-4629	3,760
Asphaltenes, weight%	D-3279	5.58
Metals, wppm		
Ni+V		68.4
Sediments and sludge, weight%	D-8470	1.0
Conversion, volume%		71.9
Composition, Volume%		
Fraction IBP-170°C		12.9
Fraction 170-360°C		26.0
Fraction 360-538°C		33.0
Fraction 538°C+		28.1
Fraction IBP-538°C+		71.9

7. Based upon the foregoing test results, the conversion removal of sulfur, nitrogen, asphaltene and metals in Test A using an operating pressure of 100 kg/cm<sup>2</sup> is 85.92%, 38.70%, 85.58% and 93.96%, respectively. However, in Test B when a higher pressure of 185 kg/cm<sup>2</sup> is used, the removal of sulfur, nitrogen, asphaltene and metals is 52.96%, 39.34%, 68.56% and 86.39 %, respectively. Although it is not totally desirable to compare two tests with slight differences in the feed properties, it is roughly demonstrated that the use of higher operating conditions like pressure and temperature in test B does not produce very promising results. The

test results essentially show that the conversion removal of sulfur, nitrogen, asphaltene and metals in Test A using an operating pressure of 100 kg/cm<sup>2</sup> are comparable or even better than those obtained in Test B when a higher pressure of 185 kg/cm<sup>2</sup> is used. Apart from the use of a slightly different feed, the test results confirm that using higher pressure (Evans et al.) does not produce great advantages as compared with lower pressure (our invention). Therefore, the lower pressure could be used to upgrade heavy crude oils or residue instead of using very high pressure and high temperature which is also very costly process.

8. Tests A and B, therefore, demonstrate that the use of a lower operating pressure achieved improved sulfur (85.92% vs. 52.96%), asphaltene (85.58% vs. 68.56%) and metal removal (93.96%, vs. 86.39 %). Also the API gravity (21.9 vs. 18) and total volumetric conversion (75.2% vs. 71.9%) are also higher using the lower operating pressure of Test A. The combination of high pressure and temperature, i.e. high reaction severity, is oriented the reaction towards the production of other light components, e.g. light gases, thus changing the selectivity and extent of the other reactions, e.g. impurities removals. These results are very significant, since using lower process pressure presents fewer, problems e.g. sediment formation, and is more cost effective than using higher process pressures or higher temperatures.

9. We have also made a brief comparison of the catalysts used in our invention and that used by Evans et al. as given below:

Our Catalysts (Table 3 of our Application)			Evans et al., Table 1		
	HDM	HDS		Catalyst A (HDM)	Catalyst B (HDS)
Surface area (m <sup>2</sup> /g)	175	248	Surface area (m <sup>2</sup> /g)	182	320
Pore Volume, (cm <sup>3</sup> /g)	0.56	0.51	Pore Volume in pores greater than 1,200 Å diameter, (cm <sup>3</sup> /g)	0.41	0.16
Mean pore diameter, (Å)	127	91	Mean pore diameter, (Å)	200	88
Molybdenum, wt%	10.66	12.89	MoO <sub>3</sub> , wt%	4.2	14.6
Nickel (NiO), wt%	2.88 (3.6)	-			
Cobalt (CoO), wt%	-	2.5 (3.2)	CoO, wt%	-	3.6
Sodium, wt%	412	-	SiO <sub>2</sub> , wt%	3.6	-
Titania, wt%	3.73	3.20	Al <sub>2</sub> O <sub>3</sub> , wt%	balance	balance

Our HDM and HDS catalysts are NiMo and CoMo supported on gamma alumina, respectively. Both catalysts also contain more than three weight percentage of titania. However, catalyst A of Evans et al. does not contain promoter (nickel or cobalt) whereas catalyst B contains 3.6 wt % CoO in Evans et al. Catalysts A and B are supported on SiO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub> and alumina, respectively. The Evans et al catalysts do not contain TiO<sub>2</sub>. It is very apparent that the functionalities of our catalysts are different than those of Evans et al. due to the presence of

different types of promoter metal or metals. Moreover, Evans et al. employed the catalysts supported by more macroporous material than in the process of our invention. Evans et al. use supports having pore volume for pores larger than 1200 Å, of about 0.1-0.4 cm<sup>3</sup>/g (Column 8, line 31). In the process of our invention, the support has pores in the range of 500-2000 Å diameter, and a pore volume for this range of about 0.34 cm<sup>3</sup>/g (0.56 cm<sup>3</sup>/g x 6.09 vol.% = 0.34 cm<sup>3</sup>/g from Table 3 of our Application). All these differences also contribute to the better results of the process described in our Application as compared with those reported by Evans et al.

10. In my opinion, the results we achieve as indicated from the foregoing tests, including low sediment formation, while using lower temperature and pressure are neither obvious nor apparent from the Evans et al. patent. The properties of the respective catalysts are different. We use NiMoTiO<sub>2</sub> and CoMoTiO<sub>2</sub> each supported on gamma alumina, which catalysts are not disclosed by Evans et al. By using the catalysts of our invention with lower temperatures and pressures, we are able to provide the advantages of the lower operating costs and simplicity of our process.

11. I hereby declare further that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing therefrom.

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Dated: \_\_\_\_\_